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tively fixed since 1832. The large telescope shows a minute companion within $1''.5$ of the large star.

The fifth magnitude star, α *Andromedæ*, is a very close and difficult pair, the distance being only $0''.8$, and the components quite unequal. This was suspected with the 12-inch, and verified and measured with the 36-inch.

HERSCHEL noted a ninth magnitude companion to α *Cassiopeiæ* at a distance of $63''$. The large telescope shows a very faint star at a distance of $17''.5$.

The distance of the close pair in γ *Andromedæ* ($0\Sigma 38$) is now less than $0''.1$. It is very difficult, and the best conditions are necessary to see the elongation at all with the large telescope.

The binary star, γ *Tauri*, has been rapidly changing. The distance now is $0''.30$.

The large refractor fails to show any third star in the system of γ *Ophiuchi*, and both components are single with all powers. At one time γ *Ophiuchi* was thought to be double ($0\Sigma 342$), but no companion can be seen here.

S. W. B.

NOTES ON STELLAR SPECTRA.

The spectra of the following stars (among many others) have been examined here during the past summer with a small spectroscope attached to the 36-inch equatorial, and in response to inquiries which have been made, I give below a preliminary statement of the results. The spectroscope which was used has no measuring apparatus, and the positions of lines are merely eye estimates.

γ *Cassiopeiæ*. This star is the most conspicuous example of VOGEL's class I ϵ , and remarkable changes in the bright lines in its spectrum have been observed by VON KONKOLY, VON GOTHARD and others. I have therefore examined it frequently, but, so far, no changes have been seen. The C and F lines are brilliant, narrow and sharp; H γ , in the violet, is seen with some difficulty. The green is full of very fine, delicate dark lines, seen only under good atmospheric conditions, the b group being somewhat more prominent than the others. There is also an appearance of faint bright lines in the green, which may be due to the actual existence of bright lines, or, perhaps, to spaces between the fine dark lines just mentioned, seeming bright by contrast. It is difficult to decide on this point. There are in all eight or ten such places. Somewhat nearer to C than to the estimated position of D is a fairly prominent dark band,

or, more probably, group of fine lines. Not the slightest trace of either dark or bright lines can be seen in the vicinity of D. The continuous spectrum close to the bright hydrogen lines appears somewhat darker than it does elsewhere, but this I have considered to be the effect of contrast.

U Cygni. This is a very red star, with a spectrum described by DUNÉR as III *b*. When examined with the 36-inch refractor it was of about the tenth magnitude, and the spectrum was dim, but the zones in the lower part could be distinguished. The blue was excessively faint. There was no appearance of bright lines.

V Cygni is also a very red star, and when examined with the spectroscope was of about the same brightness as *U Cygni*. Its spectrum is described by DUNÉR as III *b*! The sky was remarkably smoky when observations were made here, and the spectrum was dim, but at three places in the yellow and green shone with such comparative brightness that these places appeared like bright lines. The brightest was the more refrangible yellow line. It is possible that these lines may be the edges of the usual zones of class III *b*, as DUNÉR says the yellow and green zones are very bright, but the appearance was more like that of bright lines.

D. M. 43°, No. 3571. This is a star recently found by Prof. PICKERING, by the aid of photography (A. N. 2912), to belong to class II *b*. It is much like the other stars of this class found by Prof. PICKERING and by WOLF and RAYET. The faint spectrum connecting the principal bright lines in the spectra of these stars appears to be continuous with a small instrument, but with the 36-inch refractor is seen to be an extremely complicated range of absorption bands and faint bright lines. The above star differs from others that I have examined in the unusual broadness and diffuseness of these faint bands.

J. E. K.

"AN IMPROVED ASTRONOMICAL MIRROR."

A device for constructing large telescope mirrors, which has recently been patented (at an expense of \$60), is described under the above title in the *Scientific American* for September 7, 1889. The mirror is a flat, circular disc of metal, supported around its circumference by a flange or shoulder on the cell. Through a hole in its centre passes a bolt, and by turning a nut on the outside of the cell, the mirror is "buckled" into shape. The inventor has omitted to mention that by carrying the motion of the nut to a convenient position